Role Of Organic Loading Rate In Bioenergy Generation From Palm Oil Mill Effluent In A Two-Stage Up-Flow Anaerobic Sludge Blanket Continuous-Stirred Tank Reactor

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ABSTRACT

This contribution presents the technical possibilities for continuous hydrogen and methane production using an optimum organic loading rate of palm oil mill effluent in a two-stage reactor at a thermophilic temperature of 55 °C. The influence of four organic loading rates, namely, 30, 40, 50, and 60 kg COD/(m^3 d) for hydrogen production and 8.3, 10.2, 13.1, 15.8 kg COD/(m^3 d) for methane production, were investigated. Hydrogen production was controlled in an up-flow anaerobic sludge blanket reactor at a constant hydraulic retention time of 12 h. The maximum hydrogen content, volumetric hydrogen production rate and hydrogen yield were found to be 45%, 2.5 L H_2/d and 33.48 mL H_2/g COD, respectively, at the organic loading rate of 50 kg COD/(m^3 d). The effluent from the hydrogenogenic reactor was further digested into methane in the continuous stirred tank reactor at a hydraulic retention time of 5 d. The maximum volumetric methane production rate and methane yield were 10.58 L CH_4/d. and 0.11 m^3 CH_4/kg COD, respectively, at an organic loading rate of 13.1 kg COD/(m^3 d). A total chemical oxygen demand removal of 91% was achieved in this two-stage process. The scientific contribution of this two-stage technology with an optimized organic loading rate may play a significant role in degrading palm oil mill effluent and developing an energy-efficient strategy for waste management.

KEYWORDS

Renewable energy; Organic loading rate; Dark fermentation; Hydrogen production; Methane production; COD removal

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